Naval War College Review

Volume 22
Number 8 *October*

Article 8

1969

Our Navigable Waters--Polluted and Otherwise

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OUR NAVIGABLE WATERS

– – POLLUTED AND OTHERWISE

The increase in recreational watercraft has aggravated the problem of water pollution in our coastal waters. In this article an officer of the U.S. Coast Guard examines the various aspects of the pollution problem and the measures that can be taken to control it—by wisely employing the measures of control we now have available, it should be possible to produce a noticeable improvement in our waterways in the immediate future.

An article prepared by

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From the earliest colonial days, our navigable waters have served functions essential to the Nation's safety and economic well-being. Our bays and harbors, our Great Lakes, and our coastal and inland waterways are now used daily by thousands of commercial vessels, foreign and domestic, from ocean liners to tankers to barges to fishing boats. Naval vessels steam these waters, as do ships of the Coast Guard, the Corps of Engineers, and other public agencies. Recreational watercraft of all conceivable sizes also ply these waters—impressive evidence of our material prosperity.

As in other spheres of American life, the achievement of affluence has not been without expense to the quality of our natural environment. In and on the water, this cost is pollution. The threat to our navigable waters through pollution from vessels of all description is a formidable one.

Clean Water. The Water Quality Act of 1965 (Public Law 89-234), now part of the basic Federal water pollution control law, was enacted "to enhance the quality and value of our water resources and to establish a national policy for the prevention, control, and abatement of water pollution." Congress unanimously passed the Water Quality Act and, under its provisions, for the first time, specific clean-water objectives became possible. Under it, the states were permitted to plan their own specific water quality goals and to set time schedules for cleaning up their waters. The new law was especially designed, in fact, to allow the many economic and social interests in the states to determine jointly how available waters could be shared to fulfill all their various legitimate needs: recreation and aesthetics, fish and wildlife, municipal water supply, industry, agriculture, and maritime navigation.

Once determined, the act calls for the states to submit their proposed standards, including criteria, plan and implementation, and enforcement, to the U.S. Department of the Interior—specifically, to its Federal Water

Pollution Control Administration (FWPCA)—for review and approval. Once approved by the Secretary of the Interior, the standards are legally enforceable by hoth State and Federal governments. Enforcement of standards by either authority applies only to *interstate* waterways, however. (Federal law offers a financial bonus grant incentive for treatment works discharging into waters for which standards have been set, whether *intra* or *interstate.*)

Water quality standards include three essentials:

1. **Water Uses.** As required by the law, the states held public hearings to determine water uses deisred for and appropriate to each stretch of their interstate and coastal waters. In most cases, several desired uses applied to the same stretch of water. Standards were set so as to permit the highest agreed use, thus requiring other users to hring their waste treatment up to this standard. After the hearings, state pollution control officials made the final decision.

2. **Criteria.** Once uses were chosen, state authorities, in consultation with scientists, engineers, and other water experts, decided what substances and how much of each the waterway could absorb—and still be fit for the desired uses. These limits (in the act called "criteria") are expressed in terms of ranges or critical levels for such as suspended solids, heat hiochemical oxygen demands, coliform count, toxic material, et cetera.

3. **Implementation Plan.** After deciding uses and scientific criteria, state pollution control officials and technical experts surveyed municipal, industrial, and other wastes flowing into the waters to decide what type of treatment these wastes required to protect or improve the receiving waters. Then the authorities developed specific, detailed plans to produce the desired water quality.

Municipal and Industrial Wastes. The most common means of pollution control consists of a system of sewers and waste water treatment plants. The sewers collect waste water from homes, businesses, and many industries and deliver it to treatment plants designed to make it fit for reuse or discharge into receiving streams. Man-made treatment processes may be mechanical, biological, or chemical in nature. In each case they speed up the uatural processes by which water purifies itself.

Primary treatment, a mechanical process, removes solids which will float or settle out of water. Called clarification or sedimentatiou because it "clears" the water of some of its turbidity (cloudiness from suspended solids), primary treatment is the first step. If the waste water is then to be discharged directly to a receiving stream, the last step is chlorination to reduce the numher of disease-causing hacteria in the water. Primary treatment removes only about 40 percent of the organic matter in waste water. The resulting effluent, if discharged to a stream, may still cause great harm. For example, the effluent may use up most or all of the stream's oxygen supply just to decompose the remaining waste.

Secondary treatment is a biological process which duplicates nature's purification method by using bacteria to decompose organic matter in the waste water. More bacteria are used, and conditions are controlled, however, to speed up treatment. Secondary treatment can remove an additional 40 to 50 percent of the original organic matter in the waste water, giving an 80 to 90 percent efficiency for a primary-secondary plant. The final step in secondary treatment also is effluent chlorination.

Tertiary treatment is necessary in large metropolitan and/or heavily industrialized areas. Tertiary treatment, essentially a chemical process, assumes the primary-secondary steps hut goes beyond them. It may include chemical treatment in the following sequence: coagulation-sedimentation for additional solids removal (and over 90 percent reduction of phosphate concentration); filtration to remove all remaining turbidity, and absorption to remove over 98 percent of the organic matter which resists normal biological treatment. If a reduction in dissolved salts is required, electrodialysis may be the final step. Electrodialysis is generally used only if the water will be reused for municipal or special industrial purposes. With complete treatment, these further steps can remove an additional 9 percent of the original organic matter remaining, bringing total efficiency of the combined methods to 99 percent.

Obviously, none of these three processes stand alone. They must be used in combinations designed to handle each particular pollution control situation.

Properly planned, these processes can produce any degree of pollution control desired. Water produced after full treatment is of a quality suitable for any desired reuse—including water for drinking.

Other Effluents. Thus far, we have dealt with measures directed primarily towards conventional wastes such as domestic sewage or pollutants generated by industrial processes. As these wastes come under control, the more diffuse sonrces will increase in relative significance. Water qnality deterioration resulting from such sources as spills and wastes from ships and other vessels will become more noticeable. It is these nonpoint marine-related sources which are here referred to as other effluents.

There necessarily will be wide variations among other effluents in the time and manner in which their control will be required. In contrast to conventional forms of pollution for which standards require specific remedial actions within specified time periods (generally over a 5-year period), standards are less specific with regard to these nonpoint sources. The fundamental difficulty in developing water quality standards to cover other effluents is that to date there has been little effort to quantify the pollutional effects, the cures, and the prevention costs associated with such problems.

Wastes from Waterborne Vessels. In the light of the Nation's stated resolve to restore and enhance the quality of our water, we cannot afford to ignore the wastes which issue from our waterborne vessels. Indeed, logic alone demands that both efforts proceed in tandem. The ports, estuaries, straits, and channels which see heavy maritime traffic usually are located in areas of heavy population concentration. It makes little sense to expect cities and industries along these waters to clean up their own waste discharges only to have the water remain polluted by discharges from watercraft.

The problem is widespread. Vessels, mobile, may trigger local pollution at any point along their path. Tank and freight ships are larger than they used to be. So are barges. They carry more varied cargoes such as chlorine gas, crude oil and its refined products of gasoline or oils, organic chemicals and pesticides which, if spilled, persist for long periods of time to poison fish and change the whole ecology of a river, estuary, or lake. Many commercial fishing vessels are now designed as floating canneries; both canning wastes and crew sanitary wastes are discharged directly overboard wherever they operate.

A recent (1967) FWPCA study of the pollution resulting from watercraft in the navigable waters of the United States—the only one available—has produced the following findings:

1. Approximately 46,000 documented commercial vessels, 65,000 nondocumented commercial fishing vessels, 1,500 Federal vessels, and eight million recreational watercraft use the navigable waters of the United States. In addition,

about 40,000 foreign ship entrances are recorded each year for these waters.

2. The pollutants that are routinely discharged from vessels, and which degrade the waters to which they are discharged, include sewage, oils, litter, bilge water, ballast water, wash waters, and chemicals. There are also accidental cargo spills. Sewage may contain dangerous concentrations of pathogenic organisms that cause diseases such as dysentery, shigellosis, typhoid or paratyphoid fevers, gastroenteritis, and infectious hepatitis. Ballast waters may contain oils and may be grossly polluted, dangerous to public health, and highly objectionable in appearance and odor.

3. Vessel sewage is discharged to waters of the United States from commercial vessels, both United States and foreign, at an estimated rate (occupancy rate) equivalent to 199,000 persons; from federally operated watercraft, 144,000; and from the perhaps 1,300,000 recreational watercraft which are toilet equipped, 170,000. This estimated total waste discharged from all watercraft—which may be somewhat high—thus in any case approximates the wastes from a city of 500,000 people.

4. In most instances, untreated sewage is discharged from watercraft just as it has been since the beginning of navigation.

5. Watercraft pollution can thus be a serious economic and health threat to many water-use areas in the United States. Ships and boats may defile such critical areas as those used for body contact water sports, drinking water supplies, shellfish beds, and recreational lakes where organic wastes and nutrients foster algal nuisances and accelerate eutrophication. Such pollution can be grossly offensive and may adversely affect shoreline real estate and other property values.

6. Beyond these most flagrant on-the-scene abuses of the waters, pollution caused by vessels is often transient. Raw sewage and ballast water may be disgorged by a commercial vessel on the high seas today, only to foul the bathing beaches of Cape Cod, Miami, Galveston, or Big Sur tomorrow.

7. Some 279,000 persons serve aboard the 1,500 federally operated watercraft. Generally, these 1,500 watercraft do not have pollution control devices. As in the case of other sources of pollution, the Federal establishment has a special responsibility to show leadership by establishing effective programs to remedy this situation.

Local estimates of pollution by human wastes from all waterborne vessels range from 0.2 percent of the drainage basic population to as high as 1 to 5 percent in certain locations. But these are just averages. The threat from recreational watercraft, for instance, is concentrated on weekends, holidays, and at vacation periods. Thus, while the average pollution potential of just recreational watercraft is approximately equal only to that of a city of 170,000 people, the pollution potential on a foul winter's day during the middle of the week may be almost zero, and that on a fair holiday weekend during the summer may be many times greater. Pleasure craft congregating for a weekend's fun may suddenly impose a load of untreated wastes equivalent to that of a good-sized town, and this in one small area.

Harbors, lakes, and other heavily used navigable waters differ, of course, in their physical and hydrographic characteristics and, in turn, in their characteristics from the pollution control standpoint. A narrow-necked harbor, for example, may vary greatly from a relatively open bay or a wide estuary in terms of capacity to assimilate wastes without adverse consequence to other beneficial uses. In given areas, therefore, vessel pollution may assume critical importance at an early stage; on other areas vessel pollution may be hidden by other discharges or so dispersed by tide and current that it appears to be less critical. But the problem remains.

Oil Pollution. The problem of water pollution from oil spills and its destructive potential was dramatized by the *Torrey Canyon* disaster in March 1967, when that tanker ran aground off the coast of England, spilling into the seas the 119,000 tons of crude oil she was carrying. Oil spills, as well as the careless or accidental release of other hazardous materials to streams or in coastal areas, have long been of concern to water pollution authorities. The results can be serious: fish kills and harm to other marine wildlife; major aesthetic (and economic) damage.

Oil pollution arises from many sources. Major sources include ships and other vessels, pipelines, shoreside facilities (terminals), and offshore oil rigs. Coping with these largely accidental pollution incidents requires an extensive surveillance program, alerting systems, reaction capability, and a contingency fund for cleanup purposes.

Cleaning up an oil-contaminated area is time consuming, difficult, and costly. The British Government, for example, reportedly is trying to recover $8 million from the owners of the *Torrey Canyon* for cleanup costs. This does not take into account the cleanup costs to local governments and private agencies. The eventual real cost may reach $25 million. The total direct costs of cleaning up and of preventing our own oil pollution problems have not been worked out, but an oil spill is enormously expensive. The indirect costs—whether commercial, recreational, or aesthetic—are difficult to estimate but they unquestionably are also tremendous.

Oil slicks move under the influence of wind and current. Wind is the dominant factor with fresh spills on open water. Such a slick usually moves at a speed of 2 to 4 percent of the wind velocity and, in the Northern Hemisphere, slightly to the right of the direction in which the wind is blowing. In the Southern Hemisphere, the movement is to the left of the wind direction. In the absence of wind, in places such as rivers, and perhaps for older, heavier spills, current will tend to exercise greater control of a slick's movement.

A rough estimate of the amount of heavy oil on the water can be made from the appearance of the slick. A barely discernible slick indicates 25 gallons per square mile (gpsm). A silvery sheen indicates about 50 gpsm. Faint colors in the slick indicate 100 gpsm. Bright bands of color indicate 200 gpsm. At a concentration of 600 gpsm a slick turns a dull brown. A dark-brown slick indicates 1,300 gpsm.

Large crude oil slicks sometimes combine with water to form a gelatinous emulsion called "chocolate mousse." The mixture may be as much as 70 percent water. Sea agitation of some types of crude oil will create this water-in-oil emulsion.

When "chocolate mousse" is deposited on a beach it tends, because of its sticky consistency, to stay on the surface of the sand. Oil, on the other hand, depending on its consistency, may penetrate the beach. In either case, cleanup usually involves physical removal—although the deeper the oil penetrates the sand the more difficult the cleanup problem becomes.

A short composite summary of the priority of attack on oil spills—actual or potential—runs as follows:

1. Salvage of the ship (if one is involved) or at least as much of her cargo as possible. Otherwise limit the spill at the source. After this, as necessary:

2. Containment of what has spilled by use of static and towable booms or other barriers.

3. Removal of the oil from the water surface by physically picking it up (skimming or pumping) or by sinking,

burning, or chemically dispersing it.

4. Shore cleanup, using straw, sawdust, polymers, or other sorbents; perhaps chemicals; and/or variety of engineer equipment to adsorb/absorb, wash, sandblast, burn, steam, and scrape.

An important factor in almost any oil spill is the potential fire hazard. Distilled petroleum products, such as gasoline, benzene, and naphtha are the most flammable. These lighter petroleum products spread quite rapidly on water and, because of their high volatility, evaporate quickly. In open water, where no fire hazard is involved, wind and water action usually result in reasonably fast dispersal and no cleanup action need be taken. Near a tanker, pier, terminal area, or other location where the fire danger is serious, spills of such products are usually contained and fire-preventive foam spread on the surface of the slick. Subsequent evaporation removes the slick. The foam returns to a liquid state and it dissipates. Alternatively, chemical oil dispersants may be applied, for safety.

Heavier oil products rarely present as serious a fire hazard since their higher ignition point makes them more difficult to set ablaze. After a short period on the water, crude oil is difficult to ignite and attempts to burn off crude slicks in the open sea are usually unsuccessful. The volatile fractions evaporate, leaving a heavy, sticky residue. This residue—gluey, persistent—is a prime pollution offender, however.

The Federal Effort. In September 1968, the five Federal agencies most concerned with oil pollution—Interior; Transportation; Defense; Health, Education, and Welfare: and the Office of Emergency Preparedness—published a jointly agreed to National Multi-agency Oil and Hazardous Materials Contingency Plan. Under this plan, all significant spills are monitored and reported. Where other Federal response actions are required—because no one else can or will take the proper measures—they will be taken.

A Federal spill response can be divided into five phases, elements of any of which can be concurrent:

1. Discovery of the spill, notification by whatever means, and classification.
2. Containment and countermeasures, as appropriate and when necessary.
3. Cleanup and disposal of the pollutant, avoiding further damage to the environment.
4. Long-term restoration of the environment, insofar as practicable.
5. Recovery of damages and law enforcement; costs will be recovered from the spiller and legal penalties will be imposed.

Under this plan, as amended, for most spills on our navigable waters except those caused by U.S. public vessels or federally-controlled facilities, the U.S. Coast Guard will provide an on-scene commander who initiates and directs all Federal response actions. (The exceptions—the Navy, for instance—provide their own on-scene commander.) In general, however, the spiller himself will be encouraged to

BIOGRAPHIC SUMMARY

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take the corrective action and actually carry out the cleanup, under supervision.

The Coast Guard as well as the Navy and other Federal maritime agencies are also already taking measures to clean up their own problems. Extensive research is being devoted toward the development of adequate onboard sewage disposal systems for all sizes of ships, large and small. At all shore facilities where required, i.e., where the facilities cannot be tied into regular municipal sewage systems, sewage treatment plants are being installed. Intensive education and training aimed at pollution prevention is being undertaken, especially in those areas involving the handling of oil. The rest is a matter of time, money, personnel, and authority.

Other Measures. Three areas of marine-related activity not yet touched on—all of them technical in character—have considerable potential for helping prevent, control, and/or abate further pollution of our waters; all are receiving attention:

1. **Ship design and construction.** Such factors as the location, dimensions, and structural protection of a vessel's oil compartments: the size, freeboard, speed, stability, and maneuverability of a vessel; and even the location of the wheelhouse are important to accident prevention and spill minimization. The larger the tanker, the greater the threat, for instance. Various features of ship construction are already subject to control by government, industry, and the insurance-connected classification societies.

2. **Ship movement.** The best of individual ship navigation practice by properly trained and licensed masters and crews; the exercise of more positive control over the movement of oil and hazardous cargoes; the development of new and the expansion of existing recommended ship traffic lanes, at least in congested areas; and the establishment of some form of shore-based maritime traffic guidance system would all work to increase ship safety.

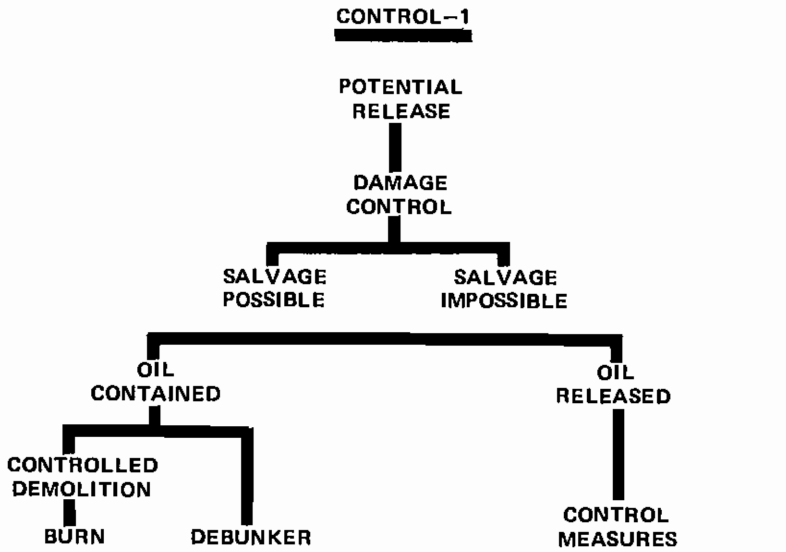
3. **Cleanup capability.** The methods and hardware required for an adequate overall spill cleanup system have yet to be developed. Our spill cure capability is much better in quiet waters than in open sea, but both areas require improvement. Extensive research and development is underway by both Government and industry.

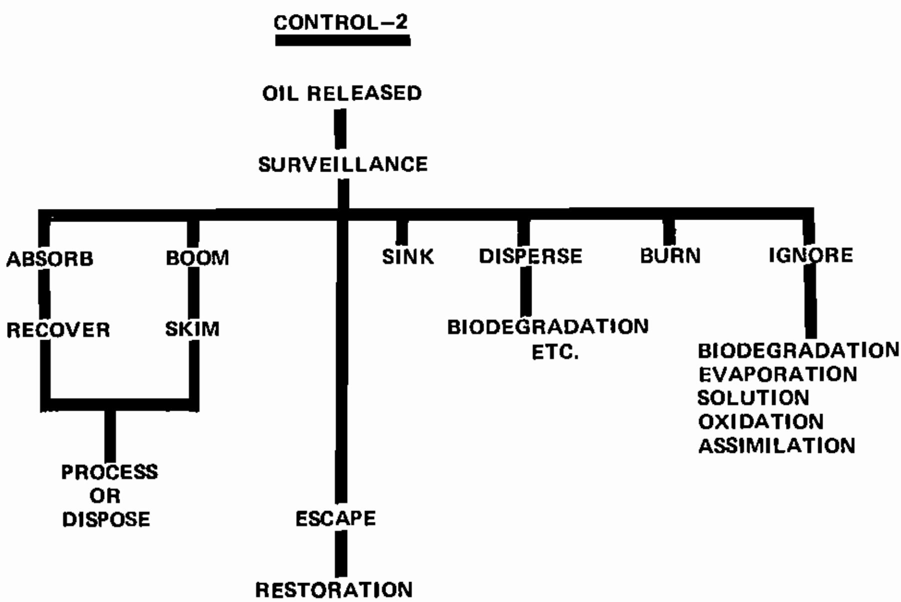
The Coast Guard thus plays a major role in the detection, investigation, and reporting of marine pollution violations, cleanup of oil spills when required, and surveillance both for enforcement and cleanup purposes. It establishes merchant vessel design safety standards, carries out merchant vessel safety inspections, documents and licenses merchant personnel. It establishes navigation procedures. It is responsible for research and development to prevent and "cure" offshore spills. It also helps formulate area contingency plans, organizing local responses to potential marine pollution incidents. For each of these tasks the Coast Guard is well qualified by its personnel, material resources, and experience.

Conclusion. The need to control the excessive and mostly unnecessary pollution of our navigable waters has been before the public for some years. Most of the means required to stop this degradation of our water and to begin enhancing this resource over the total range of beneficial public uses are now either in hand or can be secured through legislative and other measures. Much new legislation is in fact being enacted.

Marine-related pollution is just one of the sources of the problem, but nonetheless a significant one. Oil, sewage, litter, and other marine wastes will receive ever increasing pressure now and in the future. Spills will be avoided, or fought.

This all means that our waterways should become gradually cleaner over the next 5 to 10 years, with improvements showing by 1972. It is not too soon.





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